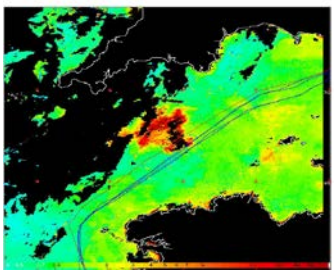
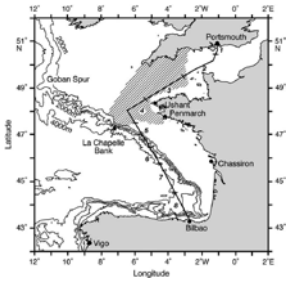
Observations of a *Karenia mikimotoi* bloom in the English Channel from a ship of opportunity



Ferry route over 7 days & MODIS image on Day 195 (14th July 2010). Satellite data can be used to track the bloom to the east after this date

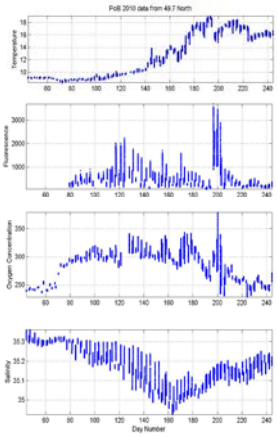
Unusually high chlorophyll values recorded on a ship of opportunity (SOO) in July 2010 indicated an intense summer bloom (>8 mg chl m^{-3} at 49.7°N 3.2°W). The bloom consisted predominantly of the dinoflagellate *Karenia mikimotoi*. It was observed via complementary datasets including continuous SOO operation and meteorological data, to investigate factors contributing to the onset of the bloom.



The Pride of Bilbao ferry route highlighting the Ushant front where the bloom was identified in region 3.

SOO data

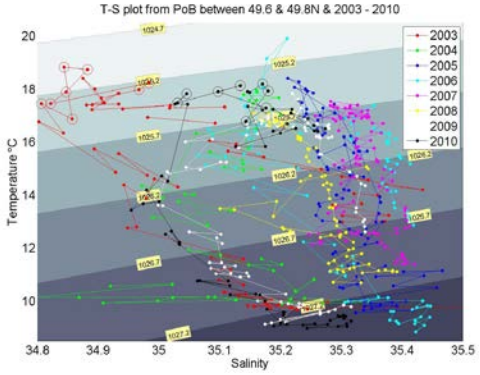
Karenia mikimotoi blooms are generally naturally occurring events in the English Channel although the intensity varies from year to year. These are identified as Harmful Algal blooms (HAB) and intense blooms have been associated with fish kills. Currently there is a poor consensus on timing controls of these summer phytoplankton blooms.



SOO 'time series' at 49.7°N, 3.4°W from 19th Feb to 2nd Sept 2010

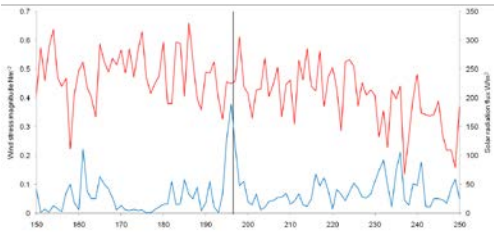
The 'time series' (left) was extracted from the Pride of Bilbao (PoB) dataset (49.7°N, 3.4°W) at the peak of the bloom in July 2010. The ferry is used as a ship of opportunity (SOO) providing *in situ* sensor and discrete sample measurements. The bloom was identified through oxygen and chlorophyll-fluorescence. It followed an increase in SST to 18.5 °C. Monthly calibration crossings provided seawater samples for analysis ashore. The species was confirmed using microscopy and a molecular biology method NASBA (nucleic acid sequence based amplification). Cell concentrations in 2010 reached over 700 cells ml^{-1}.

As in a previous intense bloom of *Karenia mikimotoi* in 2003 this coincided with the intrusion of Low Salinity Surface Water (LSSW) into the Channel. This would increase stratification in the water column. In both 2003 & 2010 the blooms are associated with low density water following periods of high temperature and low salinity (see below).



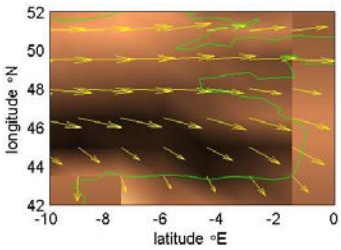
T-S plot shows FerryBox data from 49.6-49.8°N, highlighting known periods of exceptional *Karenia mikimotoi* blooms in 2003 & 2010.

Met data



NCEP wind stress (blue) & solar radiation (red) at 49.7°N, 3.4°W from 30th May to 7th Sept 2010, with the peak timing of the bloom shown as a vertical line

Although the peak of the bloom at this location coincides with a peak in wind stress this follows a period of low winds and high solar radiation (NCEP). ECMWF output suggests strong westerly winds in July, which advected the bloom to the east in the Channel.



Wind vectors & curl, July 2010 (ECMWF)

Conclusions

In July 2010 an intense summer bloom was seen from *in situ* SOO sensor measurements of chlorophyll fluorescence and dissolved oxygen. It was identified as *Karenia mikimotoi* and its occurrence was linked to high temperature & Low Salinity Surface Water (LSSW). Changes in LSSW from year to year may contribute to inter-annual variability in the occurrence of this dinoflagellate. The bloom developed in calm conditions before being advected to the east by strong westerly winds.

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